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THE AMERICAN GAS LIGHT JOURNAL

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[OFFICIAL NOTICE.]

American Gas Light Association.

OCTOBER 12, 1887.

To the Members of the Association:

GENTLEMEN: The fifteenth annual meeting of the American Gas Light Association will be held, as already announced, on Wednesday, Thursday and Friday, October 19, 20 and 21. The Convention will be called to order on the morning of the first-mentioned day, at ten o'clock, by the President, Malcolm S. Greenough, Esq., of Boston.

The headquarters will be at the Sturtevant House, and accommodations for the members will also be provided at the Coleman and Grand. The Sturtevant House is situated at the corner of Broadway and Twenty-ninth street, and is run on the American plan. The Coleman is at the corner of Broadway and Twenty-eighth street, and is run on the European system. The Grand is also on Broadway, being at the corner of Thirty-second street. It likewise is conducted on the European plan.

Members should secure rooms in advance, by writing direct to the hotel at which they intend to stop.

The meetings will be held at Dockstader's Minstrel Hall, directly opposite the Sturtevant House.

The papers so far promised are the following:

"Fuel Gas," by Emerson McMillin, of Columbus, Ohio; "Illumination *vs.* Candle Power," by Alex. C. Humphreys, of Philadelphia, Pa.; "Utilization of Residual Products," by Chas. H. Nettleton, of Birmingham, Conn.; "The Advantages of Gas Companies Engaging in the Electric Light Business," by E. J. King, of Jacksonville, Ill.; "Water Gas," by Walton Clark; "Development of the Half-Depth Regenerative Furnace and Some of the Results," by O. B. Weber, of New York; "The Comparative Illuminating Power of Gas Purified with Lime *vs.* Oxide of Iron," by C. W. Blodget, of Brooklyn, N. Y.; "Disadvantages Occasioned by Fluctuations of Candle Power in Gas Furnished to Consumers," by Richard J. Monks; "The Advantages of Regenerative Furnaces for Large and Small Gas Works," by Fred. Bredel.

We have also the partial promise of a paper treating of the value of coke for the purpose of making steam. I wish members who have any data in this direction would come prepared to give the Association the benefit of their information. I would also suggest that members be thinking over the topics contained in the foregoing list of papers, and come prepared to participate in the discussions.

Turning from the feast of reason to the lighter portion of the programme, I would remark that the banquet will be held on Thursday evening, the 20th inst., at 7:30 o'clock, at Lyric Hall, Sixth avenue and 42d street, where we will be in the hands of a well-known New York caterer. The Committee has made such arrangements that the banquet tickets will be placed at $3.

On Friday, the 21st inst., members of the Association and their ladies will have the privilege of participating in an excursion as the guests of the manufacturers of New York city and vicinity. The excursion will consist of a sail around the bay and up the Hudson to West Point, or as far as time will permit. The start will be made at 9 in the morning, luncheon will be served on board for the members and their lady friends, and, as the steamer chartered will be one of the Iron Steamboat fleet, the participants in the excursion may safely reckon on having an enjoyable day. The return will be made at 5:30 in the evening.

During the time of convention the Committee of Arrangements will endeavor to see that the ladies, accompanying members, shall enjoy their visit to the metropolis.

C. J. R. HUMPHREYS, Sec'y.

PERPLEXITIES IN THE CHIGAGO GAS SITUATION.

According to late advices it seems as if the Chicago gas situation were becoming pretty badly muddled, and that piping times are in store for those in charge of it. We have from time to time alluded to the proposed issue of bonds, the same to become a charge on the plant and

franchises of the old Chicago Company, in its capacity as a member of the recently created Trust; and all doubt as to the purposes of those behind the scenes, in respect of the bonding scheme, was removed some time since. Now, however, we are informed that Mr. J. Edward Addicks, who is not unknown in Eastern gas circles, seeks to enjoin the Trust from issuing the bonds. Further, the City Council of Chicago is said to be about to pass a resolution condemning the franchises of the Consumers and Equitable Companies—also members of the Trust—on the ground that the provisions thereof have been violated. We have no particular desire to enter into the merits of the controversy; but it does seem to us that Mr. Addicks appears to be engaged in an attempt to lock the stable door on an empty stall. Judging the men who compose the Trust to be pretty apt financiers—and some of their prior financial efforts appear to support that conclusion—we rather incline to the view that they have kept within the letter of the law. Again, the present Chicago authorities are simply suffering from the inane acts of their predecessors in office. At most, two gas companies could supply the present and future gas demands of Chicago, but owing to the inanity of the past the Chicagoese now have many companies to do the work of two. It looks to us as if the disputed charters will ultimately be found to be "quite binding." [Since the above was written, the City Council, by a vote of 28 to 5, revoked the Equitable Company's charter.]

THE FINAL WARNING.

This number of the JOURNAL contains Secretary Humphrey's final note of warning to the members of the American Association, and in fact before its hints and promises have been conned by our far-Western readers the convention will be engaged in earnest work at Dockstader's Hall. From the official notice it is learned that other gentlemen than those previously announced have promised to entertain the convention with papers, on subjects pregnant with interest to the fraternity. Indeed the list is quite promising, and its make up insures a plentitude of matter wherewith to keep the members busily engaged during the hours allotted to the strictly technical sittings of the Society. Although the local Committee of Arrangements, at the outset of its labors, encountered some difficulty in figuring out a plan for the satisfactory entertainment of the Association, it now remains to be said that those who are to profit (in a strictly pleasurable sense) by its work will subsequently agree with us that the Committee knew no such word as fail—"Cap." White and the genial proprietor of the Oregon Iron Works are aware, however, that its expurgation from their vocabulary was only accomplished by dint of labor. It will also be noticed that the price of tickets to the banquet has been fixed at $3 instead of $5, as reported in the Secretary's prior notice. We can but add that a large attendance is the only requisite needed to complete the Association's measure of satisfaction. Hence let the clans assemble.

Oil and Water Gas as Illuminants.

Mr. Chas. F. Prichard, of Lynn, Mass., contributed the following specially prepared paper to the *American Manufacturer:*

The illuminating gas commonly spoken of as water gas is in reality a mixture composed of about two-thirds water gas and one-third oil gas, the former produced by the action of incandescent carbon on steam and the latter by the distillation of petroleum or its products. The illuminating power of a gas is due to certain compounds of hydrogen and carbon called heavy hydrocarbons, a small amount being sufficient to produce considerable illuminating power. For instance, in coal gas 6 per cent. of the mixture produces the illumination. Water gas is composed as follows:

Hydrogen	45
Marsh gas	2
Carbonic oxide	45
CO^2, N., O., &c., (impurities)	8
	100

This evidently contains no illuminants and consequently has no illuminating power. The question, therefore, naturally arises why it has assumed such importance in illuminating gases if it has no illuminating power. Had it not been for the discovery of petroleum in such great quantities, its cheapness and the ready means of producing a large amount of these illuminants by its distillation, water gas would not have been known as an ingredient in illuminating gas, for the cost of adding illuminants from any other source than petroleum would have made the selling price prohibitory. Water gas is wasteful of illuminants, requiring double the amount needed by coal gas to produce the same candle-power. The ease and low cost of producing illuminants from oil has, however, offset this disadvantage, and at present prices there is no difficulty in gas made from water gas competing with other gas, if the place of manufacture is not too far distant from the oil fields.

As petroleum became plenty processes, plans and patents for the production of an oil gas multiplied. Stripped of their various details, all are substantially the same and consist in subjecting the oil to a red heat. By almost any means of accomplishing this, 70 cubic feet of 70-candle-gas can be produced from a gallon of oil. This gas is composed of about 60 per cent. marsh gas and 40 per cent. hydrocarbons or illuminants; it is of high specific gravity and costly per cubic foot, but, as its illuminants indicate, of high candle-power.

This large percentage of illuminants makes it extremely difficult to secure complete combustion, and while the result of incomplete combustion in other gases may not be noticed, in oil gases it produces a disagreeable smoke and an extremely offensive smell, particularly if the oil is crude or if, perhaps, the distillation has not been perfect. More than this, its heaviness and the difficulty which each particle of carbon in the concentrated mass meets with in its endeavor to secure its complement of oxygen results in a slow, prolonged combustion, and the production of a yellowish light, not the desirable white light which the intense heat of a quick combustion would produce. Besides these, its heaviness, cost per cubic foot, concentration requiring small burners which clogged badly, and its difficulty of distribution soon demonstrated to both manufacturer and consumer that a lighter, more bulky gas was needed.

The most obvious remedy is to dilute the oil gas, and to dilute with air is the most natural suggestion. A gas containing about one-half air makes a fairly good gas for small towns and factories, but it is a heavy mixture, of sluggish flame, not suitable for open burners of low flame temperature, and the dilution cannot be carried far enough to enable the gas to compete with other gases. The desirable qualities of a dilutent are such that it should be a combustible, of low specific gravity; that it should be generated cheaply and with rapidity, and that it should be of high flame temperature, Many gases have been tried, and in actual working to-day oil gas is combined with producer gas, mixed producer and water gas, wood gas, natural gas, the product of the "cracking-up" of natural gas and coal gas. Barring natural gas, which is of course not everywhere available, and coal gas, to which oil gas is added as an enricher, the choice of a dilutent may be brought down to producer gas and water gas.

	Producer Gas.	Water Gas.
Hydrogen	6	45
Marsh gas	3	2
Carbonic oxide	23	45
Nitrogen	65	2
Other impurities	3	6
	100	100
Specific gravity	97	57

Bearing in mind the main requisites of the diluting gas, a glance at the composition of these two gases indicates at once which is the better. Being composed almost entirely of combustible gases, water gas is far superior to producer gas in this respect. Its superior lightness is shown by its specific gravity, and its higher flame temperature is indicated, without the necessity of calculation, by the small amount of non-combustibles as compared with the larger amount of heat absorbing nitrogen in the producer, while the necessity of distributing 65 per cent. of a gas which is positively detrimental is a serious obstacle to the use of producer gas, or indeed any gas containing large amounts of non-combustibles.

Any mixture of the two gases forming what is known as producer water gas would have the same objections in a lesser degree, but still powerful enough to more than compensate for the advantages of a continuous process, which producer gas or producer water gas would have.

In conclusion, it may be said that generally speaking water gas has been found by theory and practice to be the best diluent for oil gas, which accounts for its use in the manufacture of illuminating gas, but although water gas constitutes two-thirds of the mixture popularly called water-gas, and although it bears with the public its name, nevertheless it is of secondary consideration and its use is to dilute, to aid distribution, and by its heat to intensify, the illuminating value lying latent in a gallon of oil, and the gas which actually lights our houses is oil gas, when so-called water gas is used.

We beg leave to say that, by arrangement with the Goodwin Gas Stove and Meter Company, we are prepared to offer the "Directory of Gas Light Companies in the United States and Canada," published by that house, at the price of $3 per copy.

The Effect of Carbonic Acid upon the Illuminating Power of Coal Gas.

[An article, communicated to the London *Journal*, by Mr. Jno. T. Sheard, F.C.S., Chemist to the Salford Corporation Gas Department.]

That the presence of carbonic acid in coal gas is injurious to the illuminating power of the latter is a truth not only self-evident from theoretical considerations, but realized as an actual (sometimes a distressing) fact in the experience of most gas managers. It is therefore extremely valuable, as well as interesting, to know the nature and extent of such hurtful influence. Important, however, as is this matter to the manufacturer of gas, it would seem—judging from the paucity of information that is available on the subject, and the almost complete absence from the literature of gas making of any records of actual tests—to have received little attention at the hands of experimentalists. With the exception of a paper, by Mr. C. J. Russell Humphreys, of Lawrence, Mass., read before the American Guild of Gas Managers,* I have been unable to find that the subject has come (during the last 10 or 11 years at least) before any of the now numerous Associations of Gas Managers; while such mention of it as there is in the ordinary works of reference may be summed up in the somewhat vague statement that 1 per cent. of the impurity in question reduces the illuminating power of coal gas to the extent of from 6 to 8 or 10 per cent.

Mr. Humphreys' paper is interesting and valuable, so far as it goes; but it does not go far enough. It contains the results of a series of tests upon the illuminating power of gas containing carbonic acid, and corresponding tests upon the same gas after the removal of the impurity in a lime purifier. It deals with gas from which the carbonic acid had been partially removed, by means of lime, in the ordinary course of purification; while the amount of the impurity remaining in the gas appears to have been determined only on one occasion, although the tests extended over several days. And notwithstanding that the proportion of carbonic acid in gas produced from different coals, or under different conditions of distillation, varies very considerably, there is nothing to show that means were taken to insure that the gas tested was of precisely similar composition on every occasion. Further, the actual illuminating power of the gas is not stated; the difference observed between the two series of tests only being given. From all which it will be gathered that the paper in question, lacking (or, shall we say, omitting to mention?) such desirable particulars, and, moreover, essaying to deal only partially with the subject, does not supply the whole of the information that is wanting, but leaves room for further experiments and fuller investigations.

Before proceeding to detail the results of my own experiments, which have called forth this article, it may be advisable to restate, in brief summary, the results arrived at by Mr. Humphreys, as follows: An analysis of the gas operated upon (which, as already remarked, had undergone partial purification from carbonic acid in lime purifiers) showed that it contained 1.32 per cent., by volume, of carbonic acid (CO_2). When tested in the photometer, using a "D" Argand burner, the observed illuminating power (on an average of five tests) was 0.8 candle below that obtained in corresponding and immediately succeeding tests after the gas had been completely freed from its carbonic acid in a small purifier near to the photometer. Tested by various flat-flame burners, a difference (average of 7 tests) of 1.03 candles was found. The paper subsequently proceeds to discuss the relative cost of abstracting the 1.32 per cent. of carbonic acid, and of making up for the lost illuminating power by the use of more cannel. With this branch of the subject I am not, as regards the present article, concerned.

I had long purposed the carrying out of a somewhat similar series of experiments, designed to shed light upon this subject; and, as far as might be, to determine the extent to which the illuminating power of coal gas suffers from the presence of carbonic acid. Circumstances, however, prevented me, until quite recently, from accomplishing this purpose in the careful and complete manner I desired, and which the importance of the information to be obtained demanded. While I have followed, to some extent, Mr. Humphreys' lead, I have endeavored, by more numerous and varied experiments, to secure results which should be both more valuable in themselves and of wider service; and also to supply the deficiencies which, as above indicated, detract from his otherwise valuable experiments.

The gas produced at the Salford gas works is not purified from carbonic acid, the illuminating power being maintained by the means of cannel. The first requisite for the carrying out of the experiment was, therefore, at hand. But, in order that satisfactory results might be obtained, it seemed to me essential that the gas to be tested should be of the same quality and composition throughout—in so far at least as this could be secured by the means at disposal. A supply of gas was required that might be depended upon to remain the same, in general composition, at the end as at the beginning of the experiments; so that the results should not be liable to vary by reason of differences in the proportion of carbonic acid on the one hand, or of illuminating power on the other. Accordingly, on Aug. 8, of the present year, a gasholder at one of the Salford gas stations, containing at the time about 90,000 cubic feet of gas, was shut off at both inlet and outlet, and connection made, by means of a 1-inch wrought iron tube, between its interior and the photometer. A small purifier, charged with well-moistened lime, was arranged close to the photometer, with bye-pass connections, so that the gas might proceed direct from the gasholder to the photometers, or be caused first to travel through the purifier. A second and smaller bye-pass was subsequently arranged, in order that, while passing the great bulk of the gas through the purifier, a small portion of the stream might be diverted and afterwards allowed to mix with that which had been purified. The object of this arrangement was to enable a gas containing a smaller proportion of carbonic acid than originally existed in that in the gasholder to be tested. By its means it became possible to vary artificially, so to speak, the composition of the gas passing to the photometers, and, by careful adjustment, to produce at will a mixture containing any required proportion of carbonic acid smaller than the original.

The tests commenced on the 10th of August, and continued, with occasional intervals, to the beginning of September. The first experiments were made upon the gas as it existed in the gasholder, and which contained, as will be seen, rather more than 2½ per cent., by volume, of carbonic acid. Simultaneous tests were made with the Bunsen photometer, Lowe's jet, and Sugg's illuminating power meter. In Mr. Humphrey's experiments the gas was consumed, in the Bunsen photometer, at the same rate when purified from carbonic acid as when unpurified. This, I maintain, is a faulty principle, as it is possible (and, indeed, very likely) thereby to do an injustice to the gas in one or other experiment, and it prevents the realization of that which it is especially intended to attain—viz., the consumption of the gas under the same conditions in both cases. The true principle (and that which I have adopted in these experiments) is to adjust the flame always to the height at which the gas is being burnt to the greatest advantage as regards the development of light; whereby equal justice is done to the purified and unpurified gas, and truly comparative results obtained. The observed illuminating power is in all cases corrected to the standard rate of 5 cubic feet per hour, and to the barometrical pressure of 30 inches, and temperature of 60 degrees F., so that the whole of the results hereinafter set forth are strictly comparative with each other. In the Bunsen photometer the gas was consumed through a burner similar to the one used by Mr. Humphreys—viz., a Sugg's "D" Argand, having 24 holes; and sperm candles were employed as the comparison standard. The light value of candles being notoriously variable, a different pair was employed for almost every test, as is indicated in the second column of the tables; and an average obtained from the result of ten experiments. For with candles as the standard, we cannot expect to get absolutely correct results; we can only hope, by means of averages, to approximate very nearly thereto. It must, however, be understood that in each complete experiment (consisting of a determination of the illuminating power of the gas before and after the removal of carbonic acid), the same candles were employed for the two operations. With each photometrical experiment, or group of immediately succeeding experiments upon the unpurified gas, a determination was made of the amount of carbonic acid it contained. This was effected with facility and accuracy by means of the improved method described by the writer in a recent issue of the *Journal* (*ante*, p. 240). Similar determinations were made, in some instances, on the gas after it had passed the lime purifiers; when it was found, as the result of several tests, that the amount of carbonic acid remaining in the gas was under 0.1 per cent.

Table I. contains the results of experiments with an Argand burner—the first half of the table showing the effect of 2.68 per cent. of carbonic acid (the full amount originally contained in the gas) in reducing the illuminating power; the second half showing the corresponding loss experienced when the gas contains only 1.06 per cent. of the impurity. In these results it will be noted, as of the first interest, that 2½ per cent. of carbonic acid causes a reduction of illuminating power of only 1¼ candles, or less than 7 per cent. reckoned upon that of the purified gas; and 1 per cent. of the impurity, a reduction of only two-thirds of a candle, or 3 per cent. The latter result—a loss of 0.69 candle for 1.06 per cent. of carbonic acid—agrees very closely with the result obtained by Mr. Humphreys with the same burner—viz., 0.8 candle for 1.32 per cent. It differs, however, very much from the commonly received statement that 1 per cent. of carbonic acid reduces the illuminating power 6

*See Vol. XLII., p. 288.

cent. or more. Even supposing the latter statement to refer only to common coal gas of (say) 16-candle power, I doubt very much its truth. Doubtless the effect of carbonic acid is in inverse proportion to the illuminating power of the gas, or a given percentage of the impurity will exert a less depreciatory effect upon rich gas than upon poor; but I imagine that the actual loss of illuminating power due to carbonic acid is, within moderate limits, a constant quantity, no matter what the illuminating power. That is, speaking generally, I suppose that 2½ per cent., for instance, of the impurity will cause a loss of 1½ candles, and 1 per cent. a loss of two-thirds of a candle upon gas of 16-candle power, as well as upon gas of 23 candles. Even in that case, the 1 per cent. of carbonic acid would reduce the illuminating power only by some 4 (not 6) per cent. These observations, however, are put foward merely as a thoughtful surmise on the subject, as they are based upon no actual experience. It is to me somewhat remarkable, and a result which I should hardly have expected, that the destructive effect of carbonic acid is in nearly exact proportion to the quantity contained. Thus, 2.68 per cent. of the impurity causes a loss of 1.56 candles, and 1.06 per cent. a loss of 0.69 candle; or at the rate of 0.58 candle for each 1 per cent. in the former case and 0.65 candle in the latter. Whether this correspondence would be maintained with a higher percentage, is, I think, more than doubtful. Reason would teach that the proportional effect will diminish with each increment of carbonic acid; as, indeed, the figures show that it does, but to only a very small extent.

TABLE. I.—*Sugg's "D" Argand Burner.*

Date.	Distinctive Mark of Candles Employed.	Carbonic Acid (CO_2) in Gas. Percentage by Volume.	Illuminating Power of Gas. Bunsen Photometer. CO_2 Present.	Bunsen Photometer. CO_2 Absent.	Bunsen Photometer. Difference.	Mean of Lowe's Jet and Sugg's Illuminating Power Meter. CO_2 Present.	Mean of Lowe's Jet and Sugg's Illuminating Power Meter. CO_2 Absent.	Mean of Lowe's Jet and Sugg's Illuminating Power Meter. Difference.
1887.			Candl's.	Candl's.	Candl's.	Candl's.	Candl's.	Cdles.
Aug. 10...	A	2.67	19.68	21.52	1.84	19.82	20.97	1.15
" 11...	B	2.64	20.88	21.89	1.01	20.38	21.46	1.08
" 15...	C	2.69	21.00	21.84	0.84	19.52	20.15	0.63
" 17...	C	2.60	21.78	24.64	2.86	20.52	21.60	1.08
" 18...	D	2.69	21.29	22.94	1.65	20.48	21.62	1.14
	E	2.69	21.80	23.38	1.58	20.61	21.62	1.01
	F	2.69	21.80	23.26	1.46	20.61	21.67	1.06
Aug. 24...	J	2.69	21.88	23.66	1.78	20.29	21.30	1.01
	K	2.69	23.30	24.73	1.43	20.29	21.30	1.01
Aug. 26...	L	2.72	22.57	23.74	1.17	20.78	21.70	0.92
Average...	.....	2.68	21.60	23.16	1.56	20.33	21.34	1.01
Aug. 19...	D	1.10	21.84	23.08	1.24	21.40	21.66	0.26
	E	1.10	22.16	22.73	0.57	21.40	21.66	0.26
	F	1.10	22.28	22.72	0.44	21.40	21.66	0.26
Aug. 20...	G	1.17	22.10	22.78	0.68	21.00	21.37	0.37
" 22...	H	1.01	22.63	23.39	0.76	21.04	21.30	0.26
	I	1.01	22.95	23.16	0.21	21.04	21.30	0.26
	I	1.01	21.39	22.40	1.01	21.16	21.41	0.25
Aug. 23...	D	0.99	20.92	21.68	0.76	20.70	20.96	0.26
" 26...	L	1.06	22.32	23.21	0.89	21.56	21.88	0.32
	M	1.06	22.46	22.82	0.36	21.56	21.88	0.32
Average...	.....	1.06	22.11	22.80	0.69	21.23	21.51	0.28

Specific Gravity of the Gas (Air = 1,000).

	CO_2 Present.	CO_2 Absent.
August 10	527	500
" 11	516	503
" 15	500	495
" 17	518	492
" 18 (three tests)	516	493
Average	516	496

The other most noticeable feature of the results exhibited in Table I. is the much smaller extent to which the indications of the inferential photometers are affected by carbonic acid than are those of the Bunsen. Thus, while 2½ per cent. of the impurity causes a loss of 1½ candles according to the Bunsen photometer, by the inferential photometers a difference of only 1 candle is experienced. Similarly, 1 per cent. of carbonic acid causes a loss of 0.69 candle by the former, and only 0.28 candle by the latter. This result was not altogether unexpected. It was but reasonable to suppose that, as the Bunsen photometer took cognizance both of intensity and quantity of light, while the inferential photometers recognized only the latter, the sum total of the effect of carbonic acid (which diminishes the heat intensity as well as dilutes the flame) would be greater upon the indications of the Bunsen than on those of the inferential photometer. In an article on "Experimental Investigations on Photometry," contributed to the *Journal* a year ago, the present writer, referring to this subject and reasoning from theoretical considerations, stated: "The general conclusion to be drawn * * is that coal gas containing nitrogen or carbonic acid will give higher results, as regards illuminating power, when tested in the inferential photometer, than when tested in the Bunsen; and, of the two, carbonic acid having the higher specific heat will exert the greater effect."

Having determined the effect of carbonic acid upon the illuminating power of gas when consumed in an Argand burner, it remained to do as much for burners of the flat-flame type. In order to obtain extreme yet truly representative results, two burners, each the cheapest and simplest of its class, but of widely dissimilar construction, were employed—viz., Bray's No. 3 regulator union jet, and Sugg's No. 3 steatite flat-flame. The same principle was followed in the adjustment of the rate of gas consumption with these burners as with the Argand—that, namely, of burning the particular amount of gas which could be most effectively consumed. This condition is satisfied, in the case of flat-flame burners, when the flame is just upon the point of flagging; or, with the particular burners mentioned, sufficiently near for practical purposes when the horns which form, with an excessive pressure, at the sides of the flame just disappear. The results thus obtained are contained in Table II., which is thus strictly comparative, as regards flat-flame burners, with Table I.

TABLE II.—*Flat-Flame Burners.*

Sugg's Steatite Flat-Flame Burner, No. 2.

Date.	Distinctive Mark of Candles Employed.	Carbonic Acid (CO_2) in Gas. Percentage by Volume.	Illuminating Power of Gas. Bunsen Photometer. CO_2 Present.	Bunsen Photometer. CO_2 Absent.	Bunsen Photometer. Difference.	Mean of Lowe's Jet and Sugg's Illuminating Power Meter. CO_2 Present.	Mean of Lowe's Jet and Sugg's Illuminating Power Meter. CO_2 Absent.	Mean of Lowe's Jet and Sugg's Illuminating Power Meter. Difference.
1887.			Candl's.	Candl's.	Candl's.	Candl's.	Candl's.	Cdles.
Aug. 30...	M	2.65	15.74	18.09	2.35	20.09	21.18	1.09
	N	2.65	16.13	19.29	3.16	20.09	21.18	1.09
	O	2.65	16.09	19.02	2.93	20.09	21.18	1.09
	P	2.65	16.78	19.22	2.44	20.09	21.18	1.09
Sept. 1....	S	2.63	17.86	19.95	2.09	20.10	21.14	1.04
Average...	....	2.65	16.52	19.11	2.59	20.09	21.17	1.08

Bray's Regulator Union-Jet Burner, No. 3.

Aug. 31...	N	2.58	8.72	11.68	2.96	20.20	21.27	1.07
	O	2.58	8.74	11.17	2.43	20.20	21.27	1.07
	P	2.58	8.72	11.34	2.62	20.20	21.27	1.07
Sept. 1....	Q	2.63	8.63	11.31	2.68	20.13	21.17	1.04
	R	2.63	8.32	10.66	2 34	20.13	21.17	1.04
Average...	.....	2.60	8.62	11.23	2.61	20.17	21.23	1.06
Gener'l Average)	.....	2.62	12.57	15.17	2.60	20.13	21.20	1.07

Sugg's Steatite Flat-Flame Burner, No. 3.

Sept. 7....	N	1.06	18.77	19.65	0.88	20.72	21.10	0.38
	S	1.06	18.78	19.71	0.93	20.72	21.10	0.38
Sept. 8....	T	1.04	18.32	19.48	1.16	20.62	21.05	0.43
	W	1.04	18.70	20.40	1.70	20.62	21.08	0.46
	X	1.04	18.21	19.23	1.02	20.66	21.05	0.39
Average...	.....	1.05	18.56	19.70	1.14	20.67	21.08	0.41

Bray's Regulator Union-Jet Burner, No. 3.

Sept. 3....	Q	1.18	10.07	11.06	0.99	20.52	20.90	0.38
	R	1.18	9.26	10.44	1.18	20.52	20.90	0.38
Sept. 6....	T	1.13	11.78	12.84	1.06	21.25	21.68	0.43
	U	1.10	11.76	12.42	0.66	21.25	21.68	0.43
	V	1.10	11.58	13.30	1.72	21.25	21.68	0.43
Average...	.....	1.14	10.89	12.01	1.12	20.96	21.37	0.41
Gener'l Average)	.....	1.09	14.72	15.85	1.13	20.81	21.22	0.41

A glance at the results exhibited in the second table will show that, while the observed illuminating power is in all cases much less, the difference between the illuminating power of the gas containing carbonic acid and of that from which the impurity had been removed is much greater than in Table I. Had not Mr. Humphreys' experiments shown that carbonic acid exerts a greater effect upon the illuminating power of flat-flames than of the other class, such a result might have been anticipated from theoretical considerations. The effect of carbonic acid in a flame is twofold. In the first place it dilutes the combustible gas with an inert substance; in the second, it refrigerates or cools the flame. The former action is common to, and equal in the flames of both the Argand and flat-flame burners. But it will be obvious that the cooling action of the impurity will exert a greater effect upon the flame which is the brighter or more intense—viz., the flat-flame—than upon the other; because it is notorious that the illuminating power of a flame increases in a much greater ratio than the heat intensity. Thus it comes about that 2.62 per cent. of carbonic acid causes, with flat-flame burners, a loss of illuminating power equal to 2.60 candles, and 1.09 per cent. a loss of 1.13 candles; being 67 and 64 per cent. respectively more than with the Argand burner. Calculated upon the illuminating power developed in each case, the loss is very much greater; being 17 and 7 per cent. respectively with the flat-flame burners, as against 7 and 3 per cent. with the Argand. It is a most noteworthy circumstance that, while the two flat-flame burners employed developed from the gas widely differing proportions of the total illuminating power, the actual loss of light, through the presence of carbonic acid, was practically the same. Consequently the loss, represented in terms of the amount of light developed in each case, is much the greater on the less economical burner. Thus, 1 per cent. of carbonic acid is responsible for a loss of 9 per cent. of illuminating power with the union-jet, and of only 6 per cent. with the other burner. It seems, therefore, that it is all a question of burner whether the percentage effect shall be high or low; and the very divergent statements on this head, which have hitherto constituted the only available information, are now explained. There is also observed in the results obtained with flat-flame burners what was likewise noted in the case of the Argand—that the percentage effect of the impurity in destroying the illuminating power is practically the same with the large as with the small amount.

In conclusion, let me endeavor briefly to summarize the results that have been established through this investigation. These are that 2⅜ per cent. of carbonic acid (the full amount originally contained in the gas under examination) destroyed the illuminating power of 23-candle gas to the extent of 1½ candles when the gas was burnt in an Argand burner, and of rather less than 2½ candles when flat-flame burners were employed; that 1 per cent. caused a similar loss of two-thirds of a candle with an Argand, and of rather more than 1 candle with flat-flame burners; that the actual loss of illuminating power, when flat-flame burners are employed, is practically the same, with an equal amount of impurity, whether the illuminating power developed be high or low; but, as an inseparable corollary, that the percentage loss of light increases as the "duty" of the burner decreases; and that the effect of carbonic acid in destroying the illuminating power of coal gas increases, *cæteris paribus*, in nearly equal proportion with the amount of the impurity contained.

Petroleum in Russia.

In the course of a report made to the United States Government by Jas. A. Chambers, now acting as the Consular Agent of this country at the port of Batoum, Asiatic Russia, the compiler says:

The great petroleum producing district is about 8 miles northeast of Baku, and is called Balakhani, taking the name of the Tartar village near it. Different parts of the district are known by other names, such as Sabunchi on the south, the Garden on the east, and Shaitan Bazar in the center; and local statisticians have again subdivided the fields into groups, of which there are 17 in the Balakhani district and 1 at Surakhani, about 5 miles southeast of the main district. At Surakhani there have been twenty-three wells drilled, the last one I think about the year 1879, but I find no estimate for the production of these wells, and I understand that they have produced little or no oil for several years. There is also a large refinery at Surakhani, which is supplied with crude oil by pipe-line from Balakhani.

Between 2 and 3 miles south of Baku, on the seashore, is another producing district, the area of which, as at present divided, is very small, called Bibi-Eibat. Twenty-two wells have been drilled here, and 14 of them were producing in July, 1886. In September one of those wells was drilled deeper, resulting in a large flow of oil. The production of this well, it was claimed, was from 30,000 to 40,000 barrels (42 gallons each) per day for 15 days, after which it ceased to flow entirely. This well was less than 700 feet deep, but it was the deepest well in the Bibi-Eibat district, and had been producing from a shallower depth for two years. There is also a large and very modern refinery at this place.

The depth of the wells varies from 175 to 1,030 ft., there being only one well of the latter depth, and I am not positive that it is producing profitably. The average depth of the wells is steadily increasing, and is now said to be 500 ft. as against 350 ft. in 1882. The average depth of new wells is, however, more than 500 ft. I think it is over 600 ft. By many it is claimed that the increasing depth of the drilling is proof positive of the exhaustion of the territory, and that the depth of the drilling increases 50 ft. for every 500,000,000 gallons of crude taken out, but I have seen no calculations as to the depth of the lower strata of oil. Others claim that both the yield and the quality of the crude improves with deeper drilling, and that the territory will continue to produce from much greater depths. From my own observation, I am inclined to believe that the quality of the crude as an illuminant improves as the drilling gets deeper, but as to the increase in the product I am not informed.

Even here in Russia there is a great difference of opinion as to the relative merits of Russian and American illuminating oil, and while it is not generally asserted that the Russian refined can be made as good an illuminant as the American, there is no doubt that it can be and is made to burn quite good enough for all purposes, and emits no disagreeable odor while burning.

After taking from Russian crude oil say 30 per cent. illuminating distillate, about 15 per cent. is taken from the residuum, which is called "solar oil," and which, although a nice-looking white oil, is too high fire-test to burn in ordinary lamps, and not sufficiently good for lubricating purposes. This is generally mixed with the "astatki" or crude residuum, although the last Baku congress of petroleum people "*Resolved* that its use should be made compulsory for the purpose of lighting public buildings, theatres, circuses, hotels, etc., that the use of kerosene, (refined) should be prohibited in such buildings, and that the ordinary restrictions applied to mineral oils, in transportation, storage, etc., should be taken off solar oil, and it placed in the same category with vegetable oils." This is, however, only a petroleum producers' resolution, which will be understood, no doubt, in America. After the solar oil is taken, the lubricating oil distillate is taken off, and varies from 20 per cent. to 25 per cent. From this distillate a very good lubricant is made, as it is affected neither by intense heat nor great cold. The lubricating oil is made in Baku, but great quantities of the distillate are also shipped to England, France, Belgium and Germany, and there purified and made into lubricating oils. After the foregoing proportions are taken from the crude, the residuum, down to about fifteen per cent. of the whole, is taken off, and generally mixed with the solar oil. This is called "astatki" or crude residuum, and is the fuel of southeastern Russia. As the Caspian and Volga steamers, many of the railroads in eastern Russia, and the Transcaucasian Railroad use it for fuel, there is a great demand for it, and it sells at an average price of 0.1 cent per gallon on board cars or steamers at Baku. The 15 per cent. left in the still is called "mazoot," and, as it will not burn, is a total waste. A few years ago it was used in limited quantities to sprinkle the streets of Baku, which was a very good idea from a sanitary point of view.

Estimated as above, the yield of Russian crude in merchantable products is about 85 per cent., as follows:

	Per cent.
Illuminating oil	30
Lubricating oil	20
Solar oil, Astatki (crude residuum)	35
Waste	15
Total	100

Iron tanks for crude oil are but seldom used, as is also iron pipe for conducting the crude from wells to reservoirs. Instead of iron pipe, wooden box-troughs or dirt ditches are used for the latter purpose, and reservoirs are made by excavating the ground in the vicinity of the well, or by simply throwing up walls with the sand that has been thrown out of the wells. Of course there is a loss from the ground absorbing the crude, but the price is so low that this loss is insignificant. From the reservoirs the crude is pumped through pipes to the refineries, which are located on the seashore, about two miles east of Baku, at Chornai-Gorod (Black Town).

The specific gravity of Balakhani crude oil varies, but not sufficiently to make any difference in its value, so that it is all run together, forming a crude of about 0.865 specific gravity, or 32° Beaume. It contains no

paraffine, and very little benzine is made from it, none of which is lighter than 0.700 specific gravity. As I have said before, I think it exceedingly probable that the crude will be of a less specific gravity as the drilling deepens, as I find the oil from Nobels' No. 32 about 0.850 specific or 34½° Beaume.

The distance from the wells to refineries is about 8 miles, and as the average elevation of the wells above the Caspian Sea is 175 ft., the piping of the crude is not at all difficult. There are now 14 pipe-lines, from 3 to 6 in. in diameter, and belonging to 13 different owners. The pumps used are either of American manufacture or made in England or Russia from American patterns, with the knowledge and consent of the American manufacturers and patentees. The latter, I am informed by men of experience with both kinds, are by no means as good as those made in America, and I have heard surprise expressed at the American manufacturers allowing their machinery to be so indifferently constructed in England and Russia.

The aggregate daily capacity of the 14 pipe-lines is about 100,000 barrels. The nominal pipeage charge is 1 kopeck per pood (about 4 cents per barrel), but the pipe-lines are generally owned in connection with both wells and refineries.

The great market for Russian petroleum is of course Russia itself, where it is protected from American competition by a prohibitory tariff. The Russian markets are reached principally by water transportation, *via* Caspian Sea and Volga River, to the eastern termini of the Russian railroads, and thence by railroad. Barrels were formerly used for the transportation; several barrel factories were erected at Baku and one at Tsaritzin on the Volga. The machinery in these factories is principally of German manufacture, and when made was probably as good as any in America. Now, however, it is not up to the American machinery for the same purpose. Labor was, however, cheaper than steam, and the steam-barrel works were a failure. Timber for barrels was always expensive, and the increased demand which came with the increased production made some other method of transportation absolutely necessary, and the result was the construction, for Nobel Bros., in Sweden, of a steamer to carry petroleum in bulk, which proved a great success, and completely did away with the use of barrels in the Baku trade. The Nobels have 13 of these steamers in service, carrying from 4,000 to 6,000 barrels each, all of which were constructed in Sweden and brought from the Baltic Sea *via* canal to the Volga River. The short locks in the canal necessitated the steamers being constructed so as to be taken through in two pieces and again joined together when the Volga is reached. This method of getting the steamers to the Caspian is of course very tedious and expensive, notwithstanding which there is now a large fleet of them in service.

The petroleum products are carried in these bulk steamers to a point at the mouth of the Volga River called "Davit Foot" (meaning 9 ft. of water), about 400 miles north of Baku and 90 miles from Astrakhan, where they are transferred into barges which are towed by small steam tug-boats to the various distributing points on the Volga, where tanks have been constructed for their reception and arrangements made for railroad shipments. The chief distributing point upon the Volga is Tsaritzin, about 350 miles from Astrakhan, but there is also tankage at Saratof, Kazan and Nijni Novgorod. From these points it is distributed all over Russia in tank-cars. Some is also exported to Germany *via* Riga and Libau (by sea), Eidtkunen by railroad and to Austria *via* Warsaw and Brody and Pod Volochisk. Owing to the gauge of the Russian railroad system being 5 ft., while that of the continental railroad system is the standard gauge, another transfer of the oil must be made at Eidtkunen for Germany, and at Warsaw, Brody and Pod Volochisk for Austria.

The number of tank cars in service upon Russian railroads north of the Caucasus is 2,500, or was a few months ago, as the number is constantly being increased. The tank-car is of the same style as the modern American tanks, but of uniform size and capacity, holding, nominally, 600 poods, although usually taking 660 poods or about 3,300 gallons.

Previous to the year 1883 all petroleum products were shipped from Baku by water. In that year the completion of the Transcaucasian Railroad provided another outlet to the Black Sea. Two ports on the Black Sea, Poti and Batoum, were available for the export trade, but Batoum was selected by this trade because of the superiority of its harbor and the advantage of its being a free port. The railroad company provided tank-cars to the number of 475 in 1883, and iron tanks were erected at Batoum. A can and case manufactory, with a capacity of about 7,000 cans 3,500 cases per day was erected by a large refiner of and dealer in Russian oil, the machinery necessary, together with the workmen to put it in running order, coming from America. Others also started to manufacture cans and cases by hand, and the business increased so rapidly that in 1884 and 1885 the railroad company added 750 more tank-cars to its rolling stock.

The railroad from Batoum to Baku is 560 miles long, and is an exceedingly expensive road to operate, owing to the heavy grades in crossing the mountains. The highest point upon the road is the Suram Pass, about 135 miles east of Batoum, which is over 3,000 ft. above the level of the Black Sea. Upon the west side of the mountain the average grade for 3½ miles is 185 ft. to the mile, and 1½ miles of it is 238 ft. to the mile. Upon the east side of the mountain there is a grade of 253 ft. to the mile, but the greatest grade shown by the official statistics is 238 ft. to the mile for nearly 2 miles, while the average grade for 6 miles is 210 ft. to the mile. Work will soon be commenced upon a tunnel, or rather two tunnels, a long and short one, through the mountain at Suram, which when completed will materially lessen the grade. The long tunnel will be almost 3 miles, and, as the contour of the road will have to be changed materially for 10 to 12 miles, it is estimated that the work will require about 4 years for its completion. There is some talk about the railroad capacity being temporarily increased next year by double-tracking the road over the pass, but this would also require a great deal of time and money, and I have been reliably informed that nothing of the kind is contemplated by the company. The railroad company is steadily adding new tank-cars to its rolling stock (in January 500 more tank-cars besides 350 put in service by two large refining firms.) How much these additions to the tank-car service will increase the petroleum carrying capacity of the railroad I am unable to say. It requires about 1 hour and 25 minutes for a passenger-train to cross the Suram Pass, a distance of 10 miles, and for a freight-train nearly 2 hours; and with a constantly increasing general freight business it would not seem that the petroleum carrying capacity could be increased materially. The price charged by the railroad for transporting oil from Baku to Batoum is, at present rate of exchange, about 1.4 cents per gallon, and the yard charges, etc., at Batoum will increase the price to about 1½ cents per gallon.

There are now in the oil business from Batoum 10 tank-steamers, with an aggregate yearly capacity, to the ports for which they are usually chartered, of from 75,000,000 to 80,000,000 gallons; and two or three more are reported due soon, while the carrying capacity of the railroad at present is not estimated at more than 70,000,000 gallons yearly. Thus it would seem that the gratuitous (?) puffing which the Russian petroleum business has lately had in the European press, with the very plain object of sending much needed capital to its assistance, has been only doubtfully successful, inasmuch as it has resulted in sending to the assistance of the trade, not money, but ships in such numbers as to advance the price of oil their charterers are compelled to buy, in order to keep them employed, to such a figure as to make the loss from the sale of it in European markets so great as to startle even the Russian exporter, who has heretofore exhibited such a courageous disregard of financial results. The situation must undoubtedly improve; because, at present prices for Russian refined at Batoum, profitable competition with American oil at present prices at New York is impossible, even in the Levant. Some of the many steamers chartered for the trade will be compelled to remain idle at the expense of the charterer, and of course all the charterers of these vessels feel very sure that they will not suffer in this manner, but that their competitors here must, and thus allow them to continue to export at no loss, and perhaps (with an advance in prices in America) at a profit.

The lesson the Batoum trade is now learning is undoubtedly an expensive one, and may impress upon it the fact that the price of refined at Batoum, and consequently the business of exporting, is wholly dependent upon the capacity of the railroad for carrying oil from Baku to Batoum, a material increase of which seems further away than ever, since it is currently reported and believed in Tiflis that the project of tunneling the Suram Pass has been pronounced impracticable (impossible is the word used) and abandoned by the engineers who had charge of the preliminary work. Some private tank-cars will be added to the rolling stock of the railroad in the spring, but the conditions upon which these cars are accepted by the railroad company, viz., that they can only be taken over the Suram Pass after all the cars belonging to the company are out of the way, seem to indicate a doubt in the minds of the railroad officials as to their ability to handle any more cars than are now in service.

The project of constructing a pipe line from Baku to Batoum, after having been definitely decided by a notorious English romancer, who published his specifications for the line in an English journal several months ago, was finally considered by a joint council of the ministries of Finance and State Domain, in St. Petersburg, January 12 (24 new style), and a conclusion arrived at against the construction of a line by

the Government, but ostensibly favorable to the granting of a concession for the construction of a line (for crude only, and subject to strict Government control) under certain conditions, 16 in number. I have had a translation made of these conditions, and while it would no doubt prove of great interest to American readers, in showing them the remarkable ideas held by Russian pipe line experts, I do not give it because the one clause viz., "No. 10. The company must prepare all necessary pipes and reservoirs at Russian works and of Russian material," precludes any possibility of American competition for furnishing material for it, and consequently the other conditions are of no importance to Americans. I will merely say that of the 16 conditions, there are 8, any one of which would, I believe, prevent any one with even the slightest practical knowledge of the pipe-line business from accepting this concession.

Electric Lighting from Central Stations.

Prof. Geo. Forbes, M.A., F.R.S., in addressing the members of the British Association on the above-named topic, remarked that, five years ago, disastrous speculation in purchasing and licensing patents at exorbitant rates paralyzed the financial community with regard to the public supply of electric light. A panic among gas shareholders in the House of Commons and elsewhere created, by Act of Parliament, obstacles to the industry. At the same time, crude and impossible schemes for distributing electricity, made out by incompetent persons, were tried and found wanting. The mistrust then engendered is now wholly unwarranted, and the common sense of the country must be re-awakened if this nation is to take any lead in the future applications of electricity to industry and the arts. Municipal authorities, capitalists, and members of Parliament seem to be in ignorance of the completeness of the systems now at the disposal of the electrical engineer, and of the enormous experience which we have gained by studying what has been done abroad. I hope to be able to explain away these doubts to some extent by a simple statement of the methods now generally adopted.

Having described the apparatus by which the electric light is produced, Prof. Forbes went on to say:

When I was asked to choose a subject on which to lecture to you, I felt that I should best be discharging my duty if I chose that branch of practical and applied science to which I have devoted the most attention. This subject is the means of distributing electric current to a large district from a central station. In this case a thin wire does not suffice to carry the large current required for all the lamps. Such a wire would get very hot, and more steam power might be used in heating the main conductors than in causing the lamp to shine. It is easy to calculate what size of conductor would be the most economical. I have here two great rods, each a foot in diameter, and this is the size required to supply a district with 100,000 lamps in the most economical way if the conductors were made of the best material, which is pure copper. You can see at a glance that the cost of some miles of such conductors would be prohibitive. The great difficulty of an engineering character which was encountered in the early attempts to introduce central-station electric lighting lay in the enormous cost of the copper conductors required to carry the current. This, as much as the electric lighting act of 1882, was the cause of the abandonment of all the earlier schemes. If we do not lay down thick conductors we suffer in two ways. First, the electric pressure is used up in the mains to such an extent that different consumers along the route of the mains do not get the same electric pressure, and the pressure at each house varies with the amount of light being used in other houses. Secondly, there is a great loss of energy in forcing the current through the thin mains. By thickening the mains we increase our capital expenditnre, but we reduce the annual waste of energy in the mains, and it is easy for the engineer to determine the most economical arrangement. On doing this it was found that the cost was prohibitory for supplying large districts.

Deeply interested as engineers were in the progress of electric lighting, no engineer of eminence supported these early and crude schemes. The plan originally proposed was to lay positive and negative mains all over the streets, and to connect the lamps, singly or in groups, to these mains by wires. This can only be done economically in small establishments where the greatest distance of a lamp from the machine along the route of the conductors is little more than 200 yards. It is excellent for clubs, hotels, and country houses. If we connect each pair of our lamps in series, so that the same current passes through both, the electric pressure must be doubled, but the current is halved; and at once we have a reduction in the size required for the mains. The disadvantage of this is that if one of the lamps of a pair goes out, or is put out, the other lamp of the pair also goes out, as you see when I try the experiment. Here are 12 lamps arranged in 6 pairs, and when I extinguish one of a pair the other goes out. Now, if I connect together by another wire all the wires connecting the pairs, you will see that when I extinguish one lamp there is still a course open for the current, and no other lamp goes out. But you do notice that the three top lamps are fed by the same amount of current as the six bottom ones, and are so much brighter. This is a serious disadvantage, but can be remedied by leading the middle connecting wire, which I just now introduced, to the middle of the battery or other source of electric energy which I am using. Now you see there is no difference in the brightness of the light, however many I may extinguish. This way of using three wires introduces a considerable economy in conductors, and extends the distance to which we can work economically to a quarter of a mile, as has been found from numerous trials, especially in America. This is generally called the three-wire system.

This, however, still leaves us a long distance from central-station lighting on a large scale. The idea of using high electric pressure in the mains commends itself because it cheapens our conductors. We have doubled our pressure by using the three-wire system. Can we advance farther in the same direction? If we use 2,000 volts pressure instead of 100 volts (the ordinary pressure of a glow lamp), we reduce the copper in our conductors about twenty-fold. But it is impossible to permit 2,000 volts pressure in houses where people might get shocks and be killed. It has been proposed to charge 1,000 cells of a secondary battery in series from a central station, and discharge them to a small district 50 cells in series. This would involve a storehouse for every quarter of a square mile, or even less. The system would be very good were it not for the expense of secondary or storage batteries. This puts the matter at present out of the question. It may come in time. It has the enormous advantage of leaving the system in working order even when machinery gives way, and of storing up an unusual amount of energy for special occasions, such as a general illumination. At present there is only one system thoroughly worked out for using high pressure in the mains and low pressure in the lamps. It is founded upon Faraday's discovery of induction. When I send an electric current through a coil of wire which has an iron core, the latter becomes a magnet, and continues to be one so long as the current is continued. During the act of magnetizing, a certain amount of work is done, and is stored up in the magnet. At the moment when the current ceases this energy is restored by the magnet in the form of additional current. Here I have an electromagnet with two iron limbs separately wound. The wire of one limb can be connected with an incandescent lamp; that of the other with a battery. I now pass a current through the wire on one limb. Next I connect a glow lamp with the wire of the other limb. I now break the electric circuit, and you see that the glow lamp in the second circuit glows for a moment. The energy stored in the magnet is given up to the glow lamp. An induction coil consists of an iron core surrounded by two coils, one of thick wire, the other some miles long, but of very thin wire. It also has a means for rapidly interrupting the electric current from a battery in the short thick coil. This magnetizes and demagnetizes the iron core. The iron core gives off energy to the long thin coil, and an intermittent current of very high pressure is set up in that wire. You see that long sparks flash through the air from one end of the wire to the other. I now pass the current thus obtained through a resistance equivalent to many miles of telegraph wire, and send it through the thin coils of induction apparatus at the other end of the room. This magnetizes and demagnetizes the iron core, and if I connect the thick coils of the distant apparatus with glow lamps, you see them shine brightly. Here we have a high-pressure current which can be sent over a distance of many miles through a thin wire, and then converted into the ordinary low pressure required for lighting purposes. The system, to be perfect, must be worked by a dynamo machine which gives a high-pressure current of electricity alternating in direction. The first person to use such an alternating current of high tension in the mains, and to convert it by means of efficient apparatus into a current of the ordinary pressure required for the lamps in a house, was M. Gaulard. It is now being largely used, both in Europe and America. An engineer has the greater confidence in recommending this system, because, if ever storage batteries become available, the same system of conductors will do, and no change need be made.

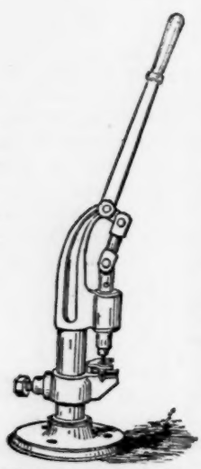
I must now say a word about the main conductors. These may be laid either overhead or underground. The former plan has most generally been adopted in England and America. In America because the prime cost is less; in England because the electric lighting act imposes prohibitive conditions on underground conductors, but does not deal with overhead ones. For a permanent works there is no doubt that underground conductors are the best, and also the cheapest in the end if

the contractors are not mulcted for the concession. It has been said that no good system of underground conductors exists. This is sheer nonsense. The plan I will explain is not by any means the only one, but I believe it to be the cheapest and perhaps the most complete. It has also the merit, as a system to describe, of novelty.

Gas pipes are laid down in the ordinary way to serve as a trough for the conductors. Gas pipes are used because sixty years' experience has taught us what they will do, and made our workmen acquainted with them; and they cost little. Two porcelain discs in each pipe serve as insulators. They are pierced with three holes (say an inch diameter) for the three-wire system, and with more or less holes in other systems, according to requirements. Through these holes are passed thin split copper tubes, which by springing out grip the porcelain insulators. Into the ends of these the ends of additional lengths of split tubing are squeezed. Thus we get a long length of gas piping, with two or three or more insulated copper tubes. These copper tubes are not the conductors, but serve other purposes. Manholes with sumps are provided at every cross street. Naked wire is drawn through the copper tubes, only as much copper wire being used as suffices for immediate wants. Additional wire can be added as consumers are added to the district. When a house is to be joined to any part of the mains, a hole is tapped in the gas pipe and wires soldered on to the copper tubes, and inclosed in a small iron gas tube screwed into the main pipe. The number of wires can at any time be added to or diminished. When the tube is two-thirds full it is difficult to pull more wire through. The old wires may then be removed and a bare cable of wire filling the whole tube drawn through. I believe that in speaking to practical working men, as I am just now, I am addressing those who can appreciate the benefits of this system, which I have not time to dwell on more fully at present. It will be described in Section G of the British Association in a few days.

In conclusion, let me say a few words on the progress of central-station electric lighting. In this country it has been slow, owing largely to the electric lighting act of 1882. If electricity be put on the same terms as gas, and if you have your station on a river bank or any place where coal and water are cheap, you can be well supplied with electric light at the same price as gas at 3s. per thousand cubic feet, with a fair profit to the undertakers. On the continent of Europe there are numerous central stations, mostly small, some supplying 30,000 lights. In America the progress has been enormous. Arc lights in series are used largely for street lighting and for shops, and central stations for glow lamps have been plentifully started on the parallel, three-wire, and induction systems. Most of the best companies concerned pay good dividends. The total money invested in electric lighting in the United States is estimated this year to amount to £30,000,000. In 1886 there were 58 Edison central stations supplying 149,000 lamps, besides 181,463 lamps in isolated plants. The Westinghouse Company has during this year been setting up central stations at the rate of 12,000 lamps per month. It is estimated that in 1885 the Brush Company alone had 96,000 arc lamps in use in the States, the number having doubled in each year from 1881. At present there are probably 300,000 arc lamps in use in that country. The Americans are also getting the start of us in electric railways. We once beat the whole world in steam railways. Our pre-eminence in steam has gone far to make this country what it is. So let it be with electricity, for we are now passing into the age of electricity.

A Handy Machine for Piercing Gas Pipes.



The Winn Device for Piercing Gas Pipes.

The recent English jubilee rejoicings were, among other things, notable for the large quantities of gas consumed in the various illuminating devices that were employed in almost every town or village that could boast of a gas works.

The Messrs. Winn & Co., of Birmingham, appreciating the fact that there would be a good demand for a handy and reliable instrument for piercing or perforating the pipes composing the illuminating devices, accordingly introduced a machine, the type of which is illustrated in the accompanying cut.

The *Engineer*, in calling attention to the Winn apparatus, says of it: "It is not only a labor-saving, but, what is more important in these matters, a time-saving contrivance. Moreover, the holes made by it are regular in size, and are all pierced straight and true."

On the Determination of Hydrous and Anhydrous Peroxide of Iron in Irish Bog Oxide of Iron.

Jas. Sutherland, F.I.C., in an article contributed to the *Gas and Water Review*, remarks that a few months ago he read with special interest the case of the Swansea Gas Company *v.* Abbott and Company, which took place before Justice Stephen and a special jury, in the High Court of Justice, Queen's Bench Division, London, and was much struck with the nature of the evidence given by the various chemists and engineers on both sides. Mr. Sutherland then continues:

Dr. Morgan, of Swansea, stated that he never met with anhydrous peroxide in bog oxide, and Mr. C. Heisch, F.C.S., F.I.C., stated there was no way of telling, by means of analyses, what amount of oxide was hydrated; and again Mr. Bernard Dyer, F.C.S., F.I.C., stated that he was not aware of any mode by which a rigid line might be drawn between the hydrated and anhydrated oxides.

Now, in our bog oxide deposits the ore exists, both in an anhydrated and hydrated condition, the anhydrous oxide being invariably hard and metallic, resembling slag or melted dross, whilst the hydrated exists when taken from the deposits as a grey, unctuous, soft clay. The depth of the deposits vary, say two to six feet thick, with a superstratum of bog or peat. Where this superstratum exists to a great depth, as it is frequently the case, it has not been found economical to work the oxide.

As is stated, the oxide (which is really a protoxide) exists as a soft, grey clay, and is easily worked—in fact, the natives handle the oxide in exactly the same manner as they do their peat. It is thrown to the surface by peat spades, and spread on the bog, being frequently turned over, so as to expose it to the atmosphere, and thereby in a few months it becomes peroxidised, changing to a light, flocculent brown.

The anhydrous oxide has rarely any covering, and is frequently associated with boulders and overlying basalt, although it is not uncommon to find it existing in a thin stratum underneath the grey clay deposit of protoxide. In such cases the *till*, or stratum underneath, is composed of hard gravel, and frequently solid rock. This anhydrous oxide is sure to be mixed more or less with the superimposed stratum, and where it exists close to the surface the temptation is strong to add it to the mass of the hydrated oxide.

Regarding now the determination of the hydration of the peroxide, it will be readily perceived that this will vary considerably in different cargoes.

The amount of combined water, so as to determine the hydration, is easily estimated by true chemical analysis. A weighed quantity is introduced into a combustion tube, one end of which is connected with a weighed chloride of calcium tube, and this to an aspirating apparatus, the other end of the combustion tube being connected with a small chloride of calcium tube, to absorb any atmospheric moisture. The combustion tube is slowly heated to redness, and the aspirator set in action. At the end of the experiment the increase in weight of the chloride of calcium tube will give the weight of combined water in the oxide taken; or in the absence of an aspirator, a combustion tube with a closed end may be used, and connected with the chloride of calcium tube.

It is, therefore, a patent fact that anhydrous oxide does exist more or less in all our Irish bog oxide of iron, and that the existence of either oxides can be easily chemically determined. Other processes for determining hydration are being continually practised here, but I consider the foregoing the most accurate.

The whole subject is one of vast importance, and I will take an early opportunity of going into such further details as will not only prove to be interesting, but advantageous, to gas managers and users of our Irish bog oxide of iron.

The Dangers of Oil Lamps.

Messrs. S. B. Newbury and W. P. Cutter, of Cornell University, have published an article (it appeared in the *Scientific American*) upon the question of the safety of modern oil lamps. To determine this the experimenters selected three of the most powerful patterns of lamps now in vogue, including one fitted with a duplex burner, and compared the action of these with that of a lamp carrying a single flat wick one inch in width. So far as could be the same flames were tested with metal and glass bodies. In all cases the temperature of the oil was taken by means of a small thermometer, the bulb of which was immersed to a depth of an inch below the surface of the oil. The lamps were lit for 2½ hours before examination; and the effect of placing a white shade upon the lamp was also tested.

The result goes to show that the temperature of the oil in a metal lamp is higher by 1° or 2° than that of a glass lamp; and when a white shade

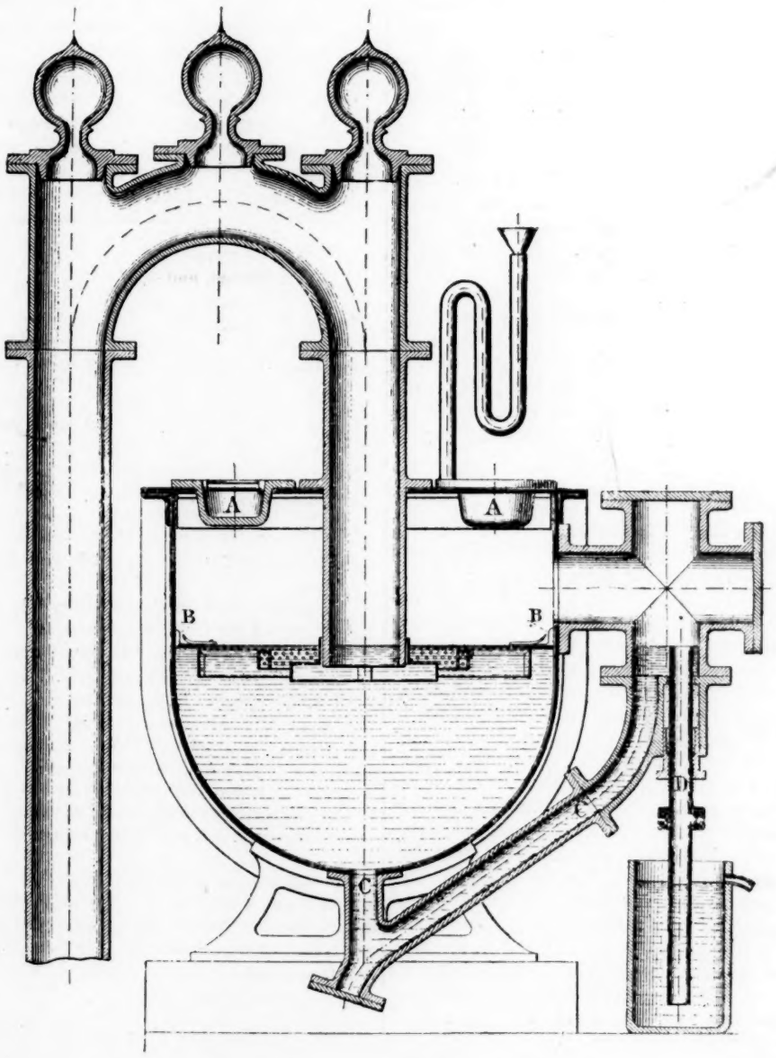
was put upon a metal lamp the temperature of the oil rose in a duplex lamp to 110° F. In a tubular wick lamp, with central air supply, the temperature was 104°. In the common single flat-wick lamp the temperature never rose above 94°. This burner may serve as the type of those generally used a few years ago; and by comparison with this the increased heat of the more powerful descriptions of lamps is clearly shown. It therefore appears that in various patterns of modern lamps the oil may be dangerously heated; and that in any case an oil which flashes below 120° is not suitable for use in a high-power lamp.

The Alavoine Plan of Hydraulic Main as Used in the Dijon Gas Works.

Something over two years ago the *Journal of Gas Lighting* published an illustrated description of an apparatus and method, devised by M. Alavoine, Superintendent of the Beauvais gas works, for separating, in the hydraulic main, the heavy properties of gas, and for generally facilitating condensation. The appliance consisted of two perforated plates, fixed at a certain distance above each other, and forming a kind of shallow box, attached to the bottom of the dip-pipe, so that the gas had to travel under water for a distance of about two feet before passing out of the hydraulic main. In this way not only was there a more complete condensation with less pressure, but the quality of the tar was improved. The arrangement of perforated plates, to which the far from inappropriate name of "strainer" was given, was applied by M. Alavoine to a number of dip-pipes at the Beauvais works, with very satisfactory results.

At the Paris meeting of the Societe Technique de l'Industrie du Gaz en France last year, the inventor gave an account of his further experience with the appliance; while at the Nancy meeting (1887) of the French Association M. Leclaire described a hydraulic main designed by him with special reference to the adoption therein of the Alavoine straining device.

The accompanying cut (it is reproduced from the *Revue Industrielle*) plainly reveals the method of working under what we may call the Alavoine-Leclaire plan. In the upper part of the hydraulic main, which is flat, there are several oval-shaped openings, *A*, arranged in zigzag order with the dip-pipes, whereby access is readily obtained to the strainers. These openings are closed by means of plugs of cast iron, the weight of which is sufficient to insure their tightness. The strainers are kept in position by two angle-irons, *B*, fixed on the vertical sides of the hydraulic main in such a way that the upper surfaces of the strainers are on the same horizontal plane. It will be seen that the gas is taken off at the side of the main, by means of a cast iron pipe communicating with the collecting main by a valve. The cooling of the main is effected by sending in a stream of ammoniacal liquor through the S-pipe fixed upon the lid. The heavy tar is removed by the pipe, *C*, which discharges the excess of tar into another pipe, *D*, which dips into an overflow vessel. This pipe, which is screw-threaded on a portion of its upper outer surface, passes into a stuffing-box, the cast iron cap of which is also threaded internally. By turning the pipe the level of the liquor in the hydraulic main may be raised or lowered—an operation which can be performed without the least inconvenience while work is going on. It is claimed for this arrangement that by it the minimum of dip is insured in all cases; while at the same time there is no possibility of the gas passing back into the ascension-pipes at the time of charging the retorts. Four hydraulic mains on this system have been installed in the new gas works at Dijon on a similar number of settings of nine retorts, placed back to back; and at the date of the French Society's meeting two of the benches had been working satisfactorily for three months.



ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

NOTICE TO LIGHTING CONTRACTORS.—Mr. J. F. Cunningham, Chairman of the Board of Trustees of the "California Hospital for the Chronic Insane," which institution we believe is located in the city of San Jose, Cal., has been authorized to receive "plans, specifications and bids for constructing, furnishing, setting up and putting in satisfactory and successful operation a system of lighting for said Hospital, either by electricity, coal gas or gasoline gas." The time limit for the reception of bids will expire at 6 o'clock P. M., Monday, Oct. 24. The bids must be accompanied by a bond in amount equal to 10 per cent. of their face value. The "bids are to include the cost of the plans and specifications, which said plans and specifications presented by the successful bidder are to become the property of the Hospital upon the awarding of the contract to such bidder or bidders."

APPOINTED SUPERINTENDENT OF LAMPS.—The Board of Commissioners for the District of Columbia have appointed W. H. Harrison to the position of Superintendent of Public Lamps, vice H. O. Bailey. Supt. Harrison took charge on October first.

CHEAPER GAS FOR STOCKTON, CAL.—Mr. Henry Adams, Supt. of the Stockton Gas, Light and Heat Company, has been empowered to again furnish practical proof of the spirit that actuates those who control the Company's affairs. Bro. Adams' pronunciamento, which bears date of Sept. 20, is a follows: "On the first day of November next the price of gas will be reduced to $2.75 per 1,000 cu. ft. The Stockton Gas, Light and Heat Company, takes pleasure in renewing the assurance of a continuation of the same liberal policy governing it in the past, and will avail itself of all improved methods for cheapening the cost of gas to our citizens. We propose to continue to furnish a superior light at the lowest possible price, even less than is charged in any other city of this State containing at least twice our population." That is the way to talk—and to *act*.

PUBLIC LIGHTING, JERSEY CITY, N. J.—The following are the bids submitted by those in interest for the public lighting of Jersey City and suburbs: United Gas Improvement Company—not less than 925 posts in old Jersey City and Lafayette, at $18 per post per annum; not less than 1,225 posts in old Bergen and Hudson cities, at $19.50 per post per annum; not less than 125 posts in Greenville, at $25 each per annum. The Company proposes to submit to a deduction of 2 per cent. for each lamp "out" on an average of 1 night per month during the year. In the proposal the Company adds the following clause: "These bids are made subject to the condition that the city shall in the contract pay to the Company $75 per month to cover damages caused by extraordinary breakage of lantern glasses and the replacement of same. This condition is made necessary by past experience, the protection afforded the lamps not being sufficient to prevent the constant and wanton breakage of glass by mischievous persons whose destructive acts ought to be prevented by the city." [The stand thus taken is an eminently proper one, and ought to be imitated by every gas company in the country.] The New York and New Jersey Globe Gas Light Company offered to maintain from 1,000 to 1,500 naphtha lanterns, at the rate of $1.62½ each per month. The Jersey City Electric Light Company offered to maintain 40 electric lights, or above or below that number at the rate of 40 cents per lamp per night, that price to be reduced to 33 cents per night in case the arcs are maintained in duty each and every night in the year.

PUBLIC LIGHTING AT LITTLE ROCK, ARK.—The residents of Little Rock are anxious that some portion of their public lighting should be accomplished under the arc method. In order, if possible, to satisfy their demands, Mayor Whipple and the Board of Public affairs are carrying on negotiations with the local gas and electric light companies, with a view to perfecting a plan whereby the gas lamps on some of the leading business streets shall be supplanted by arc lights.

MAKING IT PLEASANT FOR THE COMPANY THAT PROPOSES TO WORK UNDER THE HALL PATENTS.—A month ago we announced the incorporation of the Zenith Gas and Water Company, to operate in Duluth, Minnesota, under the system of gas manufacture outlined in what is known as the Hall patent. Mr. Wm. Craig, General Manager of the old Duluth Gas and Water Company, proposes to give the new comers an excellent opportunity of showing how cheap gas can be made and sold under the Hall process. In fact, Mr. Craig, on behalf of the old company, has published a schedule of selling rates, to take effect from first instant, that ought to "cure" the Hall people of their desire to compete with those already in possession of the Duluth field of gas supply.

CHEAPER GAS FOR PORTLAND, OREGON.—The proprietors of the Portland Gas Light Company have decreed that from and after first instant the net price of gas shall be adjusted at the figure of $2.50 per thousand cubic feet. We believe that this signifies a reduction of 25 cents per thousand. It should be added that the concession now made public only takes effect on accounts settled within 3 days from the presentation of bills.

PUBLIC LIGHTING AT EAST ALBANY, N. Y.—The village trustees of East Albany, or Greenbush, have closed a contract with the East Albany Gas Company, under which the latter agrees to maintain any desired number of gas lamps in consideration of the receipt of 9½ cents per lamp per night. The lights are to be in duty all night and every night in the year. The Company is to light, extinguish, and clean; and the burners are rated to a duty of 4 feet per hour.

A GOOD EXHIBIT.—A most interesting exhibit at the Chicago (Ills.) Exhibition is that made by the Chicago Gas Stove Company. The "dollar gas" that prevailed during the protracted war of gas rates in the wonderful Metropolis of the West taught one important thing to the Chicago housewife—that a gas cooker was and is an unalloyed blessing.

GETTING READY.—The city having awarded a contract for a mixed system (gas and electricity) of public lighting to the Cohoes (N. Y.) Gas Light Company, the proprietors of the latter have purchased the property formerly occupied as a site for a paper mill—it is close to the best dam on the Mohawk river—and are getting the structure in readiness for the dynamos. Wiring operations are being vigorously prosecuted.

BURYING THE HATCHET.—We understand that the Westinghouse Electric Light Company, of Pittsburgh, Pa., and the Thomson-Houston Electric Light Company, of Boston. Mass., will amicably terminate all existing difficulties by consolidating their forces. All suits between the Companies have been withdrawn.

GAS TRUST (ST. LOUIS, MO.) ELECTION.—Advices from St. Louis, dated Oct. 5, say: "The St. Louis Gas Trust election yesterday was a very tame and one-sided affair. The victorious interest went into the contest with over 30,000 shares pledged to it, and as that meant a clear majority of all the certificates in the Trust, the representatives of the anticipated opposition simply threw up their hands, thus permitting the uncontested election of Messrs. W. H. Thompson, James O'Connor, John R. Lionberger, H. L. Newman, and W. W. Gibbs as a Board of Trustees. At a subsequent meeting of the Board Mr. W. H. Thompson was chosen President. 38,880 shares were voted."

APPOINTED AS SUPERINTENDENT.—Mr. Henry T. Hardcastle has been appointed Secretary and Superintendent of the Appleton (Wis.) Gas Light Company. We wish him all possible success.

DO THE PEOPLE WANT IT?—Articles incorporating the Peoples' Gas Company, of Fort Wayne, Ind., have been filed with the Secretary of that State. The capital stock is placed at $50,000. Perhaps this is another sample of the Tooley street tailor's famous "resolve." Then, again, perhaps it is simply a natural gas speculation.

PUBLIC LIGHTING PROPOSALS, BUFFALO, N. Y.—Buffalo advices state that proposals for supplying the city with light, for one year from 1st. inst., were recently submitted to Councils. The Buffalo, Mutual, and Citizens Gas Light Companies offered to supply gas at the uniform rate of $1.35 per thousand cubic feet, and to keep up repairs to public lamps at the rate of 17 cents per post per month. The United States, Brush, and Thomson-Houston Electric Light Companies offered to maintain arc lights at the rate of 47½ cents per light per night. The bids were referred to the Committee on Lamps and Gas. During the discussion one astute City Father, in the person of Alderman White, expressed the grave opinion that the gas companies had been in the habit of "mixing gasoline with the gas supplied to the public lamps." He meant it, too; for, at his suggestion, the City Chemist was added to the Committee on Lamps and Gas, the "addition" being instructed to find out whether the gas men were as black as intimated by City Father White.

MARYSVILLE'S PLIGHT.—A Columbus (Ohio) correspondent writes: "I notice that you mentioned something in the JOURNAL about the Marysville (Ohio) struggle for a gas works, which leads me to say that the residents there have a most interesting fight on hand concerning this

topic. The present Marysville Council was elected on the prohibition issue, but, having occupied their seats in perfect ease and quiet for some time, they finally managed to 'raise another issue.' In hunting over the former records it was discovered that an election had been held in the town a few years ago, and the matters then balloted for, it seems, included the question whether or not a gas works should be built. The 'ayes had it,' and it was further proved that the State Legislature, by special enactment, authorized the Council to issue bonds for the erection of the coveted plant. The Council then in power, presumably for financial reasons, concluded not to exert its authority in the premises; but the present body assumed the responsibility—at least it went so far as to advertise for the sale of the bonds, and invited contractors to tender for the work. In the meantime some of those (and I fear they included many who did not greatly favor the prohibition issue) opposed to the idea—candor compels me to add that the objectors consisted largely of the taxpaying members of the community—petitioned the Council to defer the gas works project, for a time at least. The petition was granted no attention whatever, and the signers then prayed for a writ of injunction, which was temporarily allowed. The argument to make it permanent was heard at Bellefontaine, before Judge Coats, in the latter part of September, but I have not been advised as to his rulings in the case. However, that lack of information, as regards the Coates decision, is not material just now; for in any event the case will be appealed to the Supreme Court, which fact insures the retention of the gasoline public lamp at Marysville for some time to come."

THAT HAMILTON (OHIO) SUIT.—The Hamilton Gas Light and Coke Company has, in the local Court of Common Pleas, brought suit against the Cincinnati & Richmond Railroad Company, alleging as cause for action that it owns an individual interest in 110 feet of ground, fronting on High street, and extending back to the center of an old gasholder tank; that the defendants have already entered thereon with their tracks without consent from or compensation to the plaintiff; that the defendants are about to still further similarly enter thereon, and that such action will greatly interfere with and injure the gas works, etc. Plaintiff, therefore, prays for an injunction, or the issuance of an order compelling defendants to pay over a fair compensation for the right of way. A temporary restraining order was issued, and a day has been named for arguing the merits of the case. Our informant adds that "this dispute is apparent rather than real, although the gas men are far from being satisfied at the dilatoriness of the railroad folks in keeping up to their agreement. Some 3 months ago everything relative to the passage of the Pan Handle road over the land in question was settled upon between the parties, and the railroad folks assert that the preparation of the papers was only prevented because of other urgent matters that cropped out relative to the management of the road. It is well to note, nevertheless, that the urgency of the outcroppings did not prevent the railroaders from seeking to put down their rails over the coveted territory. For my part, I think the Hamilton gas men acted wisely and well, for 'an ounce of prevention,' etc., seems to suit this case quite neatly."

ANNUAL MEETING, CONCORD, N. H.—At a recent meeting of the Directors of the Concord Gas Light Company, the following officers were elected: President, John Kimball; Treasurer and Agent, John M. Hill; Clerk, Sylvester Dana. It was decided that the President and Treasurer be appointed a committee to make arrangements for the construction of a new gasholder, to be erected on the plot of land, on Turnpike street, recently purchased from Mr. Woodman. The holder is to have a capacity of not less than 100,000 cu. ft. The Directors also resolved to lower the dividend rate to 8 per cent. (10 has been the rule) until the holder expense had been wiped out. The company is in a prosperous condition, but there is small cause for wonder at that for its fortunes are controlled by wise and progressive men.

ANOTHER GAS COMPANY FOR SAN FRANCISCO, CAL.—The Standard Gas, Light and Fuel Company, to manufacture and sell gas for illumination and fuel to the city and residents of San Francisco, has been incorporated. Henry McGurren, of Chicago, Ills., Wm. B. Cluff and Jas. D. Boyer, of Alameda, and Benjamin B. Duncan and William F. Harris, of San Francisco, comprise the Directors. The capital stock is fixed at $3,000,000.

OBJECTING TO THE CHOICE MADE.—Owensboro, Ky., is not an exceedingly large place, but it seems to have sufficient attraction for gas works builders, or speculators in such operations. At any rate the owners of a new company chartered for the locality purchased a plot of land whereon to erect a works, the site selected being in the neighborhood of St. Stephens Church—a part of the city where many small residences are located. The church congregation and others of the surrounding property holders have addressed a petition to the City Council strongly remonstrating against the granting of a building permit, claiming that a gas works would not only be a great nuisance, but would also seriously impair the value of their property.

NO LONGER IN CHARGE AT POTTSTOWN, PA.—Mr. J. J. H. Bassett, who for the past 18 years acted as Superintendent of the Pottstown Gas Light Company, has resigned that post. Here is a chance to secure the services of a thoroughly competent and reliable man.

CONTRACT AWARDED.—Messrs. Mayher, Robinson and Flockhart have been awarded the contract for furnishing lamp posts to the city of Newark, N. J. We understand that $5.10 per post was the price agreed upon.

CHANGED HANDS.—Mr. C. W. Lobdell informs us that he has disposed of his interest in the franchise and plant of the Moline (Ills.) Gas Light Company; but fails to mention the name or names of those who made the purchase. We are right sorry that Mr. Lobdell has determined to step down and out.

THE SALE IS OFF.—Some time ago we announced that a syndicate, acting through Messrs. Goff, Stedman, and Sawyer, had arranged for the purchase of the Saco and Biddeford (Maine) Gas Light Company. It was supposed that all the details of the transfer had been perfected, and that by now the syndicate would be in actual possession of the property. Advices from Biddeford, under date of 5th inst., go to show that the syndicate failed to complete the agreement. Our correspondent says: "The initial steps at negotiation were taken last May, when the syndicate made an offer to President Woodman for the purchase of the plant. He refused to accept the offer then made, but named a price at which he would sell. They asked for time to consider the proposition, and the request was acceded to. The option period was subsequently extended for five weeks, or until Aug. 10; but the latter date found them still unable to complete the purchase. The syndicate then communicated with Mr. Woodman with a view to securing a third extension of time, and he declared his willingness to keep the matter open until Oct. 1, provided they posted a forfeit to prove they really meant business. The forfeit sum was deposited, but the designated day brought a despatch requesting additional grace, the saving power of the latter to become valueless at 3 P.M. of Oct. 4. On the evening of said day the gentlemen in whose hands the forfeit had been placed wired Mr. Woodman that the stock had not been taken up, and the option was no longer good. Had the sale been consummated the Kennebec electric light plant would have been removed to the gas works, and both systems of lighting thus centered in one control. While the negotiations were pending Mr. Woodman delayed the carrying out of the changes contemplated by him last spring in the carbonizing plant of the gas works, but these will now be pushed vigorously forward. Regenerative furnaces are to be introduced, the material for which construction is already on the ground. I was opposed to the sale, and am therefore inclined to say, 'All's well that ends well!'"

OTHER MAINE GAS NEWS.—We are in position to say that the Kennebec Light and Heat Company, having purchased the franchise and works of the Augusta (Me.) Gas Light Company, will make extensive alterations to the newly acquired plant. A new holder will be erected. The manager of the Company is Mr. J. W. Averill.

CHEAPER GAS FOR BELLEVILLE, ONTARIO.—Mr. S. R. Earle, Manager of the Belleville Gas Company, has been authorized to say to the residents of his city that, beginning with first day of current month, "the price of gas will be $2.25 net per thousand cubic feet. The bills will be rendered at $2.50 per thousand, and a discount of 10 per cent. given if accounts are paid at the Company's office on or before the 20th of the month." The extension of the discount period to the 20th of the month certainly affords ample time for all customers to secure the benefit of the Company's concession in the line of cheaper gas. The rate charged for gas used for domestic and power purposes remains as before—$1.25 per thousand.

PUBLIC LIGHTING AT TRENTON, N. J.—It is reported that a contract for electrically lighting the streets of Trenton has been awarded to the People's Electric Light Company. The price to be charged is 50 cents per light per night.

WHAT THE CONSOLIDATION MAY MEAN.—Elsewhere we report the fact that the Westinghouse and Thomson-Houston Electric Light Com-

panies have agreed to consolidate their interests. An exchange, in alluding to the consolidation, says: "The consolidation of the Companies named is looked upon as being very significant by electricians, who assert it is the beginning of a combination that is to extend all over the country, in opposition to Mr. Edison. The latter was recently granted a patent for the multiple arc system of distribution, which, if sustained by the courts, will give Mr. Edison absolute control of the incandescent system, and will compel the Westinghouse people, and all of the other companies now supplying incandescent lights from a central station as well, to either abandon their business or pay tribute to the erstwhile Wizard of Menlo Park. The especial patent granted to Mr. Edison covers the plan of distributing electrical power to a system of incandescent lamps from a common station, and under that protection Mr. Edison can bring suit against all of tne other incandescent systems for infringement. The effect of the granting of this patent has been to unsettle the values of other incandescent electric companies, but as Edison will be compelled to bring suit in the courts to establish the truth of the charge of infringement upon his patents by other companies, there is a vigorous legal fight in prospect—unless compromise suggests a way in which the conflicting interests may be harmonized. In any event, the Westinghouse-Thomson-Houston amalgamation makes the position of these properties much more secure than if their interests were divided."

A Table of Prices Paid for Arc Lights.—The following table shows the number (and cost per night) of public arc lights maintained in the cities and towns enumerated:

	No. Arc Lights in Use.	Price each per Night, in Cents.
Auburn, N. Y.	42	27.4
Albany, N. Y.	481	50
Atlanta, Ga.	40	39
Buffalo, N. Y.	546	60
Binghamton, N. Y.	100	50
Boston, Mass.	501	65
Baltimore, Md.	489	50
East Saginaw, Mich.	100	27.4
Fitchburg, Mass.	43	24.7
Fall River, Mass.	180	58.3
Gloucester, Mass.	11	26.6
Galveston, Texas.	50	72
Haverhill, Mass.	27	47
Ithaca, N. Y.	94	40
Knoxville, Tenn.	30	32.9
Kansas City, Mo.	27	55
Lowell, Mass.	100	55
Lockport, N. Y.	28	37
Meriden, Conn.	28	41
Minneapolis, Minn.	306	50
New York, N. Y.	1576	20 to 60
New Haven, Conn.	102	55
Norfolk, Va.	145	28.8
Nashville, Tenn.	30	50
Providence, R. I.	175	50
Peoria, Ills.	235	34.2
Poughkeepsie, N. Y.	184	35
Rochester, N. Y.	890	27
Reading, Pa.	100	45
Syracuse, N. Y.	133	39
St. Paul, Minn.	..	50
Salem, Mass.	142	47
Sandusky, Ohio.	45	24.7
Troy, N. Y.	255	47
Toledo, Ohio.	47	50
Terre Haute, Ind.	210	24.1
Utica, N. Y.	53	53
Vicksburg, Miss.	40	40
Watertown, N. Y.	90	18.6
Worcester, Mass.	113	55
Woonsocket, R. I.	41	50

Of course, in many of the places named a moon-table is followed, but we are unable to separate these with certainty. The table is a very suggestive one. The lighting value in each case cited is returned at 2,000 candles, save in New York city.

Taxes Paid by Some New Yorkers.—The receiver of Taxes for New York city (Mr. G. W. McLean) is now gathering in the shekels of those who rejoice in the possession of the "unearned" (or earned; which is it?) "increment" that occasions such great trouble to the washed and unwashed followers of Henry George. We mention Mr. McLean's present occupation simply for the purpose of making it apparent that the checks so far received by him included one for $223,310.96, drawn to the order of the city by the officials of the Consolidated Gas Light Company.

A Springer Apparatus for Emporia, Kansas.—The National Gas Light and Fuel Company is under contract to erect a set of Springer gas making apparatus at the works of the Emporia, Kansas, Gas and Electric Light Company. The plant is to have a capacity of 120,000 cu. ft. per diem. The cupola is to be of the new "pitcher-spout," solid arch pattern, similar to that in use at Lima, Ohio.

An Explosion at Toronto, Canada.—People promenading along King street (Toronto), close by where it crosses Yonge street, were, on the morning of October 4th, somewhat startled by a loud explosion. The shock to their ears was speedily followed by a surprise to their eyes, when they beheld the windows of H. L. Hime & Co.'s brokerage office making a bee-line for the center of the street, closely pursued by the flying forms of two of the clerks of the dismantled establishment. The first explosion was succeeded by others of a less severe nature, but with the general result that Hime & Co. will have to expend several hundred dollars before their counting-room shall have assumed its normal appearance. The aforesaid clerks were not much the worse, bodily, for their unconventional flight, and the others of the Hime force, including that gentleman himself, luckily escaped serious injury. Some weeks or so before the explosion, the basement and cellar in the rear of the store had been occupied as a workshop by an agent of the Toronto Portable Gas Company, and it is presumed that when the agent "moved" he neglected to take away all the "chemicals" used in "generating the gas manufactured on the premises." By way of explanation it may be said that the Portable Company's gaseous article turns out to be an old acquaintance, since the ingredients used to produce it are "sulphuric acid, marble dust, water, iron and coal oil." The furnace that heats the Hime building is located in the basement of what formerly filled the function of a gas works, and as a fire was first needed on the day of the disaster the cause of the latter is made somewhat plain. Therefore, we would say, "Rent not your cellars to makers of portable gases."

A Maryland Company and its Purposes.—Articles incorporating the Consumers Water and Illuminating Company, of Baltimore County, have been filed. The Company, according to those who created it, is formed for the purpose "of supplying pure water and illuminating gas to the towns of Woodberry, Woodlawn, Hampden and their vicinnage, and for acquiring property, maintaining buildings, and manufacturing and selling gas," etc." Messrs. J. D. Mallory, R. J. Capron, Wm. M. Busey, G. B. Morton and W. H. Watkins, comprise the Board of Directors. The capital stock is $200,000.

Notes from the West, by "Retort."—"Coal gas men have long been under the impression that the little irregularities practiced by their patrons were based on the desire of the latter to 'get even' with the former; but we now learn that our natural gas suppliers, who almost give their commodities away, are experiencing troubles like unto those of our own, since we find it reported that the Youngstown (O.) Natural Gas Company, through its Inspector, recently discovered that some of the consumers were 'boring out' their burners. In one instance the Company found that a consumer who was paying for the quantity of gas that would pass through a No. 3 burner, had, by careful boring, managed to make it equal the capacity of a No. 7.——Winfield, Kas., is to have an arc and incandescent electric light plant, the same to be owned by the city. Bonds are to be issued to meet the expense incurred.——Mr. Conway, Secy. of the Wichita (Kas.) Gas Light and Power Company, is pretty busy just now. In addition to putting down a large amount of new main pipes, he found it necessary to thoroughly overhaul the old ones because of a largely increased leakage account. The services gave out rapidly, too—the trouble in both instances can be traced to peculiarities in the soil of the vicinity—and they are to be replaced by galvanized iron pipe. The city has recently ordered 100 additional street lamps. Mr. Conway is also erecting a very elaborate gas arch, spanning Main street, to the order of the local Museum Company.——The Bellevue (Ky.) Company, mention of whose novel plant was made in my last letter to the Journal, seeks new territory for conquest. Its proprietors have cast their hook into Newport, and the City Council seems to be nibbling at the bait. A legal fight is anticipated, and apparently provided for.——Gen. Hickenlooper's return to Cincinnati from his wanderings in foreign lands was made memorable by the rousing reception given him by the employees of the Cincinnati Gas Company. Speeches, music, flowers, and cheers were showered on him

almost before he crossed the sidewalk in front of his house. Although somewhat taken aback, the General met the volley of goodwill in thoroughly characteristic fashion."

KILLED BY THE CURRENT.—Sept. 25, F. Nelson, in employ of Brush Company, Philadelphia, Pa. Oct. 3, H. Corliss, lineman, Brush Company, Detroit, Mich.

A NEW SOUTHERN ENTERPRISE.—On Oct. 8 the Jeter and Boardman Gas and Water Association was incorporated at Macon, Ga., with a capital of $200,000. The object of the Company, as indicated by its title, is to build, operate, lease or purchase gas, water and electric light works throughout the "New South." Its officers are: W. A. Jeter, of the Brunswick (Ga.) Gas Company, President; A. E. Boardman, of the Macon (Ga.) Gas Company, Secretary and Treasurer; and Messrs. J. W. Wilcox, J. H. Campbell, and J. S. Scofield (all of Macon), Directors. We wish the new venture every success, and must say it starts out quite promisingly, having already secured the right to construct water works at Sumter, S. C., also at Ocala and Tampa, Fla.

Gas Into Electricity.

A recent issue of the Boston *Sunday Herald* said:

In its September number *Practical Electricity* has an interesting account of "an unique lighting plant" in Spencer, Mass., in which gas furnishes the motive power, and by means of gas engines and dynamo machines is transmitted into electricity for lighting purposes. Some thing over a year ago the *Herald*, in an article on gas and electricity, ventured the prediction that the time would come when a better and more intense illumination could be had from gas by means of the gas engine and dynamo electric machine than from the gas itself; and, according to the article in *Practical Electricity*, this has been accomplished in Spencer. From the account in that journal, it appears that early last spring the gas company of Spencer—of recent establishment—began to consider the question of electric lighting, and first tried the experiment of operating 25 arc lights in the town by means of a single 10-horse power gas engine and a small steam engine belted to counter shafting. Although not a success from an electrical standpoint, the people of the town were immensely pleased, and, in a public meeting, they voted, authorizing the selectmen to make a contract with the Spencer Gas Company to furnish 60 arc lights for one year, at 33⅓ cents each per night. Three new Otto gas engines were purchased, an extra dynamo, additional lamps to make a full quota of 60, and the necessary wiring was also accomplished. On the first day of last July the entire plant was put in operation, and has been successfully operated since that time.

A visit by a representative of *Practical Electricity* to the plant at Spencer gives sufficient data and evidence to show that gas can be cheaply and successfully used to do an electric lighting business. Three Otto gas engines, with an indicated total capacity of 45-horse power, were operating two Ball dynamos. The dynamo pulleys had a speed of 1,200 revolutions; but of the 45-horse power of the engines the writer estimated that the dynamos actually received not more than 36-horse power of energy. "Nevertheless," he writes, "both engines and dynamos worked magnificently, and will work better after having been longer in use. Taking both engines and dynamos at their best at this rating, sufficient power was given off to successfully operate at least 20 more lights. The amount of gas consumed in the run of 4½ hours was 3,910 cubic feet. Calling it in round numbers 4,000 cubic feet, there was an expense for fuel of $2, the cost of the gas being rated by the Company at 50 cents per thousand cubic feet. Hence the cost of the 60 lights on the circuit was 3⅓ cents per lamp for 4½ hours' run. It will be seen, further, that, in this case, the dynamos were operating very nearly two lamps per horse power. The writer has not the smallest doubt of the approximate accuracy of the above figures. Finally, it may be said that the only items of expense to be figured into the cost of operating these lights are the salary of the man ($15 per week) who looks after the station and the lamps and conductors also, the cost of the carbons, and the oil used for lubrication. The rental of the room is virtually nothing."

Correspondence

[The JOURNAL is not responsible for the opinions expressed by correspondents.]

Tar Pavements.

OFFICE OF STRATFORD GAS COMPANY,
STRATFORD, ONTARIO, Sept. 29, 1887.

To the Editor AMERICAN GAS LIGHT JOURNAL:

I read with much interest your report (contained in issue of JOURNAL for Aug. 2) of the discussion, at the meeting of the Western Gas Association, on the uses to which the tar made on gas works may be put. Noting that many of the members of the Association seemed to have been quite successful in constructing tar-made roadways or footwalks, and having had some experience in that direction I thought that a description of the method pursued here would be acceptable to your readers. From one cause or another I deferred that recital till now, for we are at the present time using up in the manufacture of asphalt walks the tar made in our works since last June.

At first, or about ten years ago, by way of a trial, we used tar mixed in with common cinders in our plan of sidewalk construction. We took the cinders as they came from the furnaces adding sufficient tar to thoroughly saturate them, and placed the mixture (about 4 or 5 inches in depth) over a piece of footwalk that had a good clay bed. The mixture was then rammed and rolled until it had been thoroughly packed. Now, although I may say that that section of footway shows no sign to-day of wear and tear, we have done a good deal of experimenting since then with the result that we claim to be able to make a first-class tar sidewalk not only at much less expense, but also a much more durable footway is secured, than if wood were employed. Further, we get as good price for our tar as any that I have seen reported in the JOURNAL. I may say we have either ourselves mixed or sold to others for asphalt mixing purposes, all the tar made by us during the last four years, and the demand is rapidly increasing. In fact our City Council have passed a resolution authorizing the local Board of Public Works to contract with us for a supply of asphalt for next season.

Our process of preparing the material is to first crush the cinders quite fine (we subsequently pass them through a screen fitted with a 1-inch by ⅜-inch mesh), and then add coarse, clean sand to them—using the same screen—in the proportion of 2 parts sand to 1 part cinders. To 1 cubic yard of the compost we add about 0.75 of a barrel of tar, and with rakes thoroughly mix the mass until it, for want of a better expression, acts like thick brown sugar does when the latter is disturbed by the hand—that is, it appears to "crawl" on being moved. At first our mixing process was a slow operation, but practice taught us how to advance. By means of the apparatus now in use we can mix quite rapidly. In fact, with three men, we are able to mix 10 cubic yards per day; and that quantity is taken by the city, the authorities removing it from our premises. The city puts this pavement down, and makes a charge of $5 for each cubic yard.

We erected a furnace to heat the compost, and the following will describe its features: The heating pan (it is estimated to contain 1 cubic yard) is made of boiler plate, being 10 feet long by 4 feet wide, and 9 inches high, on three sides, the remaining side being open in order to facilitate shoveling. Pieces of T-iron are riveted on the bottom of the pan, in order to prevent warping because of the fire underneath. This pan is placed on a brickwork structure, which rises about 2 feet from the ground, built furnace fashion, with furnace door and grate bars, and a stack in the rear. By using a very small quantity of wood we are able to heat 1 cubic yard of the composition as fast as the men can prepare another.

The tar is pumped directly into a caldron that is arranged with a coil of pipe through which steam is passed. Thus it is seen that all the components of the mixture are kept in a heated state, and that the operation is easily and readily performed.

The composition (asphalt, we call it here) is spread to a depth of 3 inches over a properly prepared bed lined out in just the shape required to be taken on when finished—the Stratford authorities have usually put the mixture over a specially prepared gravel bed, but that precaution I consider unnecessary. Indeed, some two years ago I experimented with the mixture on a simple clay bed, and I firmly believe, from the teaching of that trial, that the clay-bedded walk will outlast the gravel-bedded ones. I am satisfied that anything of an over-porous character will not answer for a tar walk foundation, for the underneath drying-out action must cause cracking in the upper mass. On the other hand, a solid, firm bed will hold the under side of the asphalt in an elastic manner, with durability as the result.

At Stratford we give these tar made walks no protection when once they are finished. The finishing process consists in rolling them thoroughly with a 700-pound roller—sprinkling a little fine sand over the mass when it is spread, in order to keep the roller from tearing up the mixture. When the rolling is completed the walk is covered with a nice coat of thin sand, and the footway is ready for use.

Believing that I have occupied too much of your space, nevertheless if our experience here in this instance in disposing profitably of a bye-product in gas making is worth anything to the fraternity, I shall feel grateful.

Yours truly,

JOHN READ, Manager.

THE AMERICAN GAS LIGHT JOURNAL

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MONDAY, OCTOBER 17, 1887.

Western Waifs.

By DIAPHRAGM.

Your correspondent, on the occasion of a recent visit to Jacksonville, Ills., found the urbane King indisposed. It was a question whether he would feel able to endure the fatigue consequent on the journey East to attend the convention. It is to be hoped he will show up, smiling and entirely well. He has been very busy indeed. Jacksonville has paved a mile and a-half of her streets, thus far this season, and the Gas Company has relaid on these streets larger mains, renewed every old service, and put in services to curbstone on each vacant lot on the line. There is yet as much more to do before December. Two new settings of 5's are going in, a new meter room (32 by 18) is under way, and a new 5-ft. station meter is being built. Considerable water pipe has also been laid, to serve as an additional fire protection. The day consumption is increasing. Besides a number of engines more than 100 gas stoves are in use. That the coke trade is good is evidenced by the fact that the Jacksonville Gas Light Company is more than 3,000 bushels behind the orders now on the books for that residual. Among contemplated improvements for next year I note a new holder (60 ft.), and a building to house additional electric plant. By the-way, Mr. King has for sale purifiers, condensers, hydraulic main, and other apparatus that go to make up a six-inch plant. The present Jacksonville plant is an 8-inch one throughout.

President Wakelee. of the Battle Creek, Mich., Company, reports a steady gain in business. They have put in a new setting of sixes, and completed over a mile of main extensions this season. Next year much more work will be necessary.

Said Supt. Decker, of Hannibal, Mo., "Our town is not booming, as all Western towns appear to be. Our growth, however, is steady, and the Gas Company's business increases in similar manner. We have no reason to complain, and prospects are bright. We have done nothing in the way of extensions or improvements. How is the water company? Powerful busy; me, too."

Dame Fortune has smiled kindly upon Col. John Dell, of St. Louis. Unearthing his money from fireclay mines, the Colonel invested in silver mining stocks, all of which turned out well—particularly, one block of 2,000 shares (purchased at 25 cents per share) is now worth $1.25, and none selling. John's many friends will be glad to hear of his good luck.

The expiration of electric light contracts at Vincennes, Ind., is keeping Supt. Ramsdell quite busy. His report at the end of the fiscal year shows an increase of 20 per cent. in consumption—very gratifying, certainly, to Mr. Ramsdell and his directors. The Laclede people are building a new bench of sixes—half regenerative—for Vincennes.

"The improvements at St. Joe, Mo., are progressing rapidly, and it is hoped to have everything in order by Nov. 1," said Secretary Farish, to the writer, recently in St. Louis.

The many friends of Supt. Cannings, of Henderson, Ky., will sympathize with him in the loss of his son, a bright young man of 24 years, who was buried Oct. 2. The project agitated in the City Council to light the streets of Henderson with electricity has been abandoned—gas is good enough. A new bench of 6's (Evens & Howard) has been erected, and a new tower condenser and scrubber (from Stacey Manufacturing Company) was placed on the first of this month. Business has been beyond Mr. Cannings' most sanguine expectations. Next season another bench of sixes, and a new rotary exhauster as well, will be added to the plant.

President Griswold, of the East St. Louis Gas Company, having disposed of his valuable Forest Park property, has bought a house in and taken up his residence at Castleton, Vt. Pretty far away, eh? He still retains his interests at E. St. Louis, and, under Supt. Ewing, good results are guaranteed. Over a mile of new pipe has been laid this season to meet the demands of a rapidly increasing consumption. Besides extending the retort house and adding therein a new bench of 3's, besides other improvements on the plant, three very nice cottages have been erected, in close proximity to the works, for the use of the men in the employ of the Company. Much new work is laid out for next season.

Your scribe had a pleasant visit last week with "Gus" Littleton, at Quincy, Ills. Though very busy the weary traveler was received and granted a hearing. Although no improvements worthy of mention were made at the Quincy plant this year, the purchase, on the 1st inst., of the local electric lighting company by the Gas Company marks an important era in the history of the latter institution. There is much work ahead for Supt. Littleton.

Supt. Coffey, of the Peoria (Ills.) Gas Light Company, has returned from his tour of Europe, vastly improved in health—information that will delight his numerous friends.

There promises to be an exodus of Western men to New York. The writer predicts a larger number of Western men will attend the American convention this year than appeared at any meeting heretofore held in the East.

The Market for Gas Securities.

The city market for gas shares remains in a state similar to that which we have been obliged to chronicle for the past two or three months. We hold, however, to the opinion that a lively upward turn will shortly take place in Consolidated. Other city gas shares are weak and lower, Equitable having suffered a loss of 5 points in the fortnight. Brooklyn shares maintain their recent values fairly well, and we incline to the view that Nassau and old Brooklyn present good opportunities for investment purchases. The Chicago situation, as will be noted in other pages of this issue, is decidedly mixed just now, but Trust certificates at quoted prices look very tempting. The Baltimore war of rates still keeps money out of the pockets of holders of Monumental City gas shares, but shrewd observers predict that the end of the knifing operation draws near. Eastern gas shares are on the up-track—in fact it is hard to say what figures would really tempt holders to part with their pet securities. The Montreal Gas Company is now paying the regular semi-annual dividend of 6 per cent. The annual meeting of the Consumers Gas Company, of Toronto, is to be held on the 31st inst.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks.

16 WALL ST., NEW YORK CITY.

OCTOBER 17.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	71	—
Central	440,000	50	30	—
" Scrip	220,000	—	47	57
Equitable	2,000,000	100	110	115
" Bonds	1,000,000	—	113	115
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	110	113
Mutual	3,500,000	100	88	91
" Bonds	1,500,000	1000	101	—
Municipal, Bonds	750,000		—	—
Northern	125,000	50	30	—
" Scrip	108,000			
Yonkers		50	—	80
Richmond Co., S. I.	300,000	50	50	—
" Bonds	12,000	—	—	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	—	102
Citizens	1,200,000	20	50	—
" S. F. Bonds	320,000	1000	—	103
Fulton Municipal	3,000,000	100	125	128
" Bonds	300,000		—	106
Peoples	1,000,000	10	57	60
" Bonds (5's)	368,000	—	97	—
" " (6's)	94,000	—	100	—
Metropolitan	1,000,000	100	75	78
Nassau	1,000,000	25	—	100
" Ctfs.	700,000	1000	95	100
Williamsburgh	1,000,000	50	112	115
" Bonds	1,000,000	—	111	—
Out of Town Gas Companies.				
Boston (Mass.) Gas Co.	2,500,000	500	220	—
Buffalo Mutual, N. Y.	750,000	100	90	95
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	140	145
" " Bonds	45,000	—	—	—
Chicago Gas Trust	25,000,000	100	34	36
Cincinnati G. & C. Co.	6,000,000	100	182½	185